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A NEW COURSE FOR MIGRATING ANCYLOSTOMA AND STRONGYLOIDES LARVAE AFTER ORAL INFECTION

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The modes of infection and course of migration for Ancylostoma and Strongyloides have been accurately and decisively investigated by various helminthologists old and new; especially recent works by Looss and Fülleborn have decided almost all problems in the subject so fully that no further investigations are needed.

Ancylostoma and Strongyloides larvae are believed to infect in two ways, through the skin and the mouth, the former being the more prevalent manner of infection. The course of the migrating larvae in the host is essentially the same in both cases of skin and of oral infection. Sooner or later they migrate into the lungs by means of blood vessels or sometimes by the lymph system; then the majority of the larvae in the lungs pass through the trachea, esophagus and stomach to the small intestine where they grow into the adult form; but a few of them migrate from the lungs to the intestinal wall by way of the blood vessels, passing through the pulmonary vein, heart and mesenteric arteries, whence they penetrate into the canal of the intestine where they become mature.

This is the universally recognized course of the larvae in the body of the host. In connection with my study on the migration of ascarid larvae in the body of their host, it occurred to me that the well defined course of Ancylostoma and Strongyloides larvae in the host although the principal one, may not be the only one. The following experiments will serve to test not only the new course of migrating Ancylostoma and Strongyloides larvae, but prove definitely my proposal regarding the migration of ascarid larvae.

For the experiments Ancylostoma larvae were cultured from eggs from human feces and filariform Strongyloides larvae were obtained from a culture of eggs from the feces of some monkeys.

Exp. 1. At 5 p. m. on July 17, 1918, two guinea-pigs, A and B, were fed with the Strongyloides larvae cultured for nine days. Animal A was killed at 1 p. m. on the next day, twenty hours later. Two specimens of active larvae were found in the pleural cavity and three in the abdominal, but none in the lungs.

Exp. 2. At 9 a. m. on July 24, a guinea-pig was fed with the Strongyloides larvae cultured seven days and it was killed at noon on the next day, twenty-seven hours later. Six specimens were found in the abdominal cavity, two in the pleural and two in the left lung but none in a piece of the liver. Pancreas unexamined.

Exp. 3. Animal B of Exp. 1 was killed at 9 a. m. on July 19, forty hours after feeding. Two living larvae were found in the abdominal cavity and three in the lung which was slightly blooded, also three in a piece of the liver and one in the pancreas.

Exp. 4. At 11 a. m. on July 19, a guinea-pig was fed with the Strongyloides larvae cultured eight days and at 11 a. m. on the twenty-third, ninety-six hours later, it was killed. Abdominal examination was interfered with on account of bleeding by cutting the liver carelessly. Only one specimen in the pleural cavity, three in the right lung and two in a piece of the liver. Pancreas unexamined.

Exp. 5. At 11 a. m. on July 19, a guinea-pig was fed with the Ancylostoma larvae cultured eight days and at 1 p. m. on the next day it was killed, twenty-six hours after feeding. Two worms were found in the pleural cavity, five in the abdominal cavity, many in the lungs, a few in the liver and three in the pancreas.

Exp. 6. At 9 a. m. on July 24, a guinea-pig was fed with the Ancylostoma larvae and at 3 p. m. on the next day it was killed, thirty hours later. Three were in the pleural cavity, four in the abdominal, many in the lungs, two in a piece of the liver and one in the pancreas.

Exp. 7. During three hours from 9 to 12 a. m. on July 22, Strongyloides larvae six days old were smeared from time to time on the abdominal skin, where the hair was cut off closely and shaved, and the animal was fixed on the holder until 5 p. m. Then it was put in the cage after the smeared part had been cleaned. At 9 a. m. on the next day, about twenty-four hours later, it was killed. Four were found in the abdominal cavity and two in the pancreas, but none in the lungs, pleural cavity or in one-half of the liver.

From the above experiments one may easily assume the two facts that: 1, Ancylostoma and Strongyloides larvae introduced into the alimentary canal of the feeding animal may appear in the abdominal and pleural cavities at least twenty-four hours later, and may penetrate into the liver, pancreas and lungs; 2, Strongyloides larvae smeared on the shaved skin of the abdomen may pierce through the abdominal wall and appear in the abdominal cavity or penetrate into the organs of the cavity in about twenty-four hours.

The piercing power of Ancylostoma and Strongyloides larvae is commonly recognized without which skin infection or further migration into the intestinal wall by the larvae infected, is not easily explained. The above experiments also show the fact clearly that the larvae may pierce through the skin or the wall of the alimentary tract.

Appearance in the pleural cavity of larvae introduced into the alimentary canal is explained in two possible ways: 1, the larvae may pierce through the esophageal wall and reach the pleural cavity and 2, the larvae may pierce through the gastral or intestinal wall to enter first the abdominal cavity, and thence proceed to the pleural cavity by passing through the diaphragm. Previous authors frequently reported finding larvae in the esophageal wall. So the first way may be supposed to exist. From the result of the above experiments as well as from my conclusion obtained by experiments on the migration of ascarid larvae, it seems to me, however, that the second way is the more common and usual course of the larvae reaching the pleural cavity.

Thus I am strongly inclined to believe in the piercing power of larvae in their migration, during which they enter the abdominal cavity by boring the alimentary wall and thence proceed to the pleural cavity by passing through the diaphragm and lastly penetrate the lungs from the surface, as in the case of ascarid larvae. This will be probably a new course for the migration of Ancylostoma and Strongyloides larvae in the body of the host.

Fülleborn described finding Strongyloides larvae not only in the lungs but in the liver and kidneys of a dog fed with the larvae and explained the appearance of the larvae by their migration by way of blood vessels. His theory may be true. However, I believe it is also reasonable to explain the presencec of larvae in these organs by direct penetration from the surface by means of their own piercing power. Some larvae in these organs may certainly be considered to have penetrated from the abdominal cavity which they reached from the intestine by passing through its wall. The larvae in the pancreas of my case may also be understood to have entered the organ from its surface, not by way of blood vessels.

There may be hard places for the larvae to pass from the intestine to the kidney, if they go by means of blood circulation. Thus it will be harder for the larvae to reach the kidneys and pancreas from the intestine by way of blood vessels than by the direct penetration into the organs from their surface by their own piercing power.

Several authors report cases in which they found many larvae in the tissues of the intestinal wall instead of in the blood vessels. Might this not be a case showing their penetration through the tissues? And some investigators described relatively scant occurrence or even absence of larvae in the liver of the infected animal whereas the lungs were heavily invaded. This may, of course, be partly attributed to an incomplete examination, but is also easily explained by assuming the direct migration of the larvae.

I am inclined to believe that the direct penetrating migration of Ancylostoma and Strongyloides larvae in passing through the tissues of the host, is a new course, additional to the old well known route by the blood vessels.